PATENT SPECIFICATION

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COMPLETE SPECIFICATION

NO DRAWINGS

Improvements in or relating to Nutrient Food Bases

We, HOWARD LLOYD & COMPANY LIMITED, a British Company of Clerk Green, Batley, Yorkshire, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:

This invention is concerned with the production of a nutrient food base, useful in particular for the preparation of soft drinks, soups, meat products, meat extracts and other food preparations.

The object of the invention is to provide an improved nutrient food base using as starting material whey or whey products.

It is a further object of the invention to provide an improved soft drink using such nutrient food base.

Whey is a readily available material as a by-product of cheese manufacture. It contains a substantial proportion of protein, but its use in the manufacture of foodstuffs is limited by unpleasant flavour and other factors. Attempts to use whey have, however, been made including hydrolysis to a product comprising amino acids and/or polypeptides. However, the hydrolysis of whey often gives rise to a product which is either of little nutrient value and/or possesses undesirable flavour characteristics.

We have found that by hydrolysing whey under certain controlled conditions, hereinafter described, which whey has previously been subject to pasteurisation, a product is obtained having good nutrient properties and whose flavour characteristics are such as to enable it to be used in the production of a wide range of food products having either sweet or savoury taste characteristics.

According to the invention, therefore, there is provided a process for the production of a nutrient food base which comprises the steps of pasteurising whey and hydrolysing the pasteurised whey at a pH between 2.5 and 7.0 by means of a proteolytic enzyme operating under these pH conditions.

The whey used in accordance with the present invention can be untreated natural whey (for example as received from a cheese-maker) or it may be condensed or protein enriched either before or after pasteurisation. Whey powder (reconstituted) can also be used. The more concentrated forms of whey can be diluted as necessary in order to give a product of desired characteristics.

The whey product submitted to hydrolysis is firstly pasteurised, which process serves to destroy undesired enzymes and micro-organisms present which are likely to cause fermentation and the development of undesired flavours. The pasteurisation step frequently induces some denaturing of protein which serves to increase its reactivity towards the proteolytic enzyme and thus favours the subsequent hydrolysis step. The pasteurisation may be carried out by a batch or continuous process, for example, by heating at temperatures between 75-100°C. for from 30 minutes to five seconds, followed by rapid cooling. As will be understood, shorter times must be used at higher temperatures, it being desirable to avoid excessive precipitation of protein. At lower temperatures, however, longer times are required to ensure complete pasteurisation. In general, for ordinary liquid whey, pasteurisation for one minute at 80°C. is found satisfactory.

The hydrolysis of the pasteurised whey, in accordance with the present invention, is carried out by means of a proteolytic enzyme at a pH between 2.5 and 7.0, advantageously between 4.0 and 7.0, the enzyme being one operating under these pH

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conditions. The selection of pH conditions represents an important feature, in accordance with the present invention, since hydrolysis at other pH's is accompanied by undesirable side reactions. Preferably the hydrolysis is carried out at pH's between 5.0 and 6.0.

The enzyme used for hydrolysis should be a physiologically harmless proteolytic endyme operating in the stated pH range, and should preferably be an enzyme which will hydrolyse proteins to polypeptides rather than amino acids. Many enzymes can be used such as pancreatic enzymes such as trypsin and pepsin, plant enzymes such as ficin and papain as well as bacterial and fungal proteinases. Fungal proteinases are particularly advantageous, for example, such as may be derived from organisms of the genus *Aspergillus*, e.g. *Aspergillus oryzae*. One such enzyme is, for example, marketed under the designation Rhozyme P-11. The temperature of hydrolysis should be as high as possible, but must, of course, be one compatible with the enzyme used. In the case of the enzyme Rhozyme P-11, a temperature of 48-55°C. is preferable. The higher the temperature, the less favourable are the conditions for the development of micro-organisms.

The hydrolysis is preferably carried out for such a time that not more than 40% of the total nitrogen of the product is precipitable by trichloracetic acid. Preferably also at least 20% and advantageously at least 40% of the nitrogen present should be present as free amino groups. Where the product is to be used for the production of sweet as distinct from savoury food products, for example, for the production of soft drinks, not more than 60% of the total nitrogen and desirably not more than 50% should be present as free amino groups. For the preparation of savoury products, however, the amino-nitrogen can exceed 60% of the total nitrogen, an increase in free amino groups tending to develop a meaty flavour. It is generally advantageous from the point of view of quality and nutritional value of the product as well as taste characteristics that not more than 25% of the total nitrogen be precipitable by trichloracetic acid.

It is advantageous in the manufacture of soft drinks from the whey hydrolysate first to manufacture a base from which the soft drink can subsequently be made, for example either by simple dilution with water or with soda water. Where it is desired to make such a base from fresh whey it is desirable, after pasteurisation and if necessary filtering, to concentrate the fresh whey, for example, by vacuum evaporation or by means of continuous evaporators of the falling film or rising film type prior to hydrolysis according to the invention. The extent of the concentration will depend on just how concentrated it is desired to prepare the soft drink base, but it is generally advantageous to concentrate the fresh whey to form 10% to 40% of its original volume e.g. to about 20% of its original volume.

The concentrated whey hydrolysate may then after suitable sweetening and flavouring be supplied in bulk for subsequent bottling or for dispensing after suitable dilution at the point of sale.

By concentrating the fresh whey prior to hydrolysis according to the invention the equipment in which the hydroysis is carried out may be used to better advantage apart from the advantages of being able to market a concentrated product.

In the manufacture of dietary preparations from the whey hydrolysate according to the invention the ratio of protein to carbohydrate may be improved by removing part of the lactose contained in the whey hydrolysate. Thus, it has been found that if the whey hydrolysate is further concentrated, say to $\frac{1}{8}$ of its original volume, and chilled, a high proportion of the lactose present will crystallise, and may be removed, e.g. by filtration. In this way it has been found possible to prepare a whey hydrolysate having a hydrolysed protein content of 6.5 to 5.7% and a lactose content of 16.0 to 18.0%. This product has unexpectedly been found to be a clear, golden-yellow, slightly viscous fluid having a pronounced but pleasant savoury flavour of a meat-like type.

The protein-enriched whey hydrolysate may conveniently be used as a base into which to incorporate further high protein ingredients to yield a product having a high concentration of essential nutrients with a low carbohydrate content. A suitable additive is, for example, soya flour, which may be added in the proportion of one part of soya flour to one part of the concentrate having the above analysis: this composition, after blending with vitamin concentrates and mineral elements, provides a food which is specially advantageous for the feeding of invalids and for use in a calorie restricted diet.

The hydrolysed product, according to the invention, can be used as a base or additive for a wide variety of food products of sweet or savoury nature. The product contains the nutritional elements of whey in a readily assimilable form, and is unexpectedly found to have a pleasant flavour, lending itself to the production of pleasantly tasting products of high food value. It may be used in liquid form for the preparation of liquid products, or alternatively it may be dried, for example, by evaporation or spray drying for the production of a dry powder

suitable for compounding in solid food products. When used in liquid form, the product is preferably further pasteurised after hydrolysis and then clarified as necessary e.g. by filtration or centrifugation. Alternatively or in addition, pasteurisation of the final product may be undertaken after incorporation of the base therein. Pasteurisation after hydrolysis appears to improve the characteristics of the product, and where this is undertaken conditions of pasteurisation can be employed similar to those used on the whey itself.

The food base prepared in accordance with the invention, in liquid form, has proved to be particularly useful for the preparation of soft drinks. The product may thus be admixed with sugar, glucose or other sweetening agents, together with suitable flavouring agents, e.g. natural fruit juices, fruit esters or other natural or synthetic flavours. Colouring matter and/or thickening agents may be added as desired. In general the pH should be adjusted to suit taste and keeping requirements, the preferred pH being in general between 2.5 and 5.0. pH Adjustment can take place with acids such as citric, tartaric, lactic, malic or phosphoric acids. The preferred pH in the case of fruit base drinks is 3-3-3.6.

The soft drink product may be advantageously carbonated to any desired degree.

In order to increase the nutritive value of the whey hydrolysate it has been found that lysine may be added, for example as its monohydrochloride, without substantial detriment to the flavour of the finished product. For example, the nutritive value of soft drinks may be improved by the addition of 0.2% lysine monohydrochloride.

Even where pasteurisation of the food base has taken place before blending, the final product is also preferably pasteurised either before or after being filled into containers. If carried out before filling into containers, the filling operation should be conducted aseptically into sterile containers.

In general, we prefer to carry out the production of soft drinks using the food base product according to the invention which has been pasteurised, and wherein the final pasteurisation is carried out after filling into suitable containers. After both pasteurisation steps, rapid cooling is desirable.

In another modification of the invention a dietary preparation, particularly suitable for people desiring a restricted carbohydrate intake, can be prepared. Thus the nutrient base, preferably prepared from a protein enriched whey (i.e. whey from which lactose has been removed following concentration) is combined with suitable non-calorigenic thickening agents, e.g. methyl cellulose, carboxymethyl cellulose, alginates, pectin or gelatin, and flavouring materials, vitamins and/or other nutrients added as desired. In such preparations the carbohydrates level can be adjusted as desired, e.g. by the use of appropriate quantities of starch or sugar or alternatively no carbohydrate need be added. The pH is adjusted to suit taste requirements.

For the better understanding of the invention, the following examples are given only as illustrations :—

Example 1

100 ml. of fresh whey which has been filtered free from fats and insoluble material are treated with sodium hydroxide to bring the pH to 5.3-5.6. The liquid is flash pasteurised by heating for 1 minute at 80°C. and then cooled rapidly to about 20°C.. 50-70mg. of Rhozyme P-11 are added and the whole mixed thoroughly. The mixture is heated to 48 to 52°C. and maintained at this temperature for 24 hours and then cooled. The resultant product has 50% of its nitrogen as free amino groups and only 25% of its original protein present in a form precipitable by trichloracetic acid, 8 g. of sucrose, 2.5 ml. of 8 times concentrated apple juice, 1.5 ml. of concentrated grenadine juice and 12.0 mg. of benzoic acid are added to this mixture. The pH is adjusted to 3.3-3.6 with phosphoric acid.

When thoroughly mixed, the product is flash pasteurised by heating to 80°C. for 1 minute followed by rapid cooling to about 20°C. The liquid is filtered through a bed of diatomaceous earth. After carbonating to the equivalent of 2½ volumes, the product is filled into bottles and these are sealed.

Finally, the sealed bottles are placed into boiling water and the contents maintained above 80°C. for five minutes. They are then cooled as rapidly as possible.

Example 2

Example 1 is repeated except that the pH of the whey is adjusted with calcium hydroxide and 20 mg. of Pancreatic Trypsin (Novo), a technical enzyme preparation prepared from pork and beef pancreas, used at 40°C for 24 hours.

In the product, 31% of the nitrogen is present as free amino groups, 70% of the original protein present in soluble form and only 30% of the original protein present is a form precipitable by trichloracetic acid. The hydrolysate is cooled to 20°C, 8 g. of sucrose, 2.5 ml. of eight times concentrated apple juice, 5 ml. of a lemon juice and 12.0 mg. benzoic acid added. The pH is adjusted to 3.3-3.6, using lactic acid and the liquid carbonated to 2½ volumes. The product is then pasteurised by heating under pressure at 80°C for three minutes, cooled as rapidly

as possible and filtered through a bed of diatomaceous earth, and then filled aseptically into sterile bottles.

Example 3

1,000 ml. of filtered whey is concentrated in vacuo to 200 ml. The concentrate is treated with sodium hydroxide to bring the pH to 5.3-5.6, then heated to 75°C for 30 minutes to effect pasteurisation, followed by rapid cooling.

600 mg. Rhozyme P-11 are then added and mixed thoroughly: the mixture is heated at 48-52°C for 24 hours to effect hydrolysis and then cooled. The hydrolysed product is flash pasteurised for one minute at 80°C, followed by rapid cooling to prevent further enzyme action.

The resultant mixture contains 3.5-4.0% of protein in soluble form. 140 mg. benzoic acid, 100 gm. sucrose, 35 ml. conc. grenadine juice, 15 ml. of concentrated apple juice and 2 g. of lysine hydrochloride are added and the ph adjusted to 3.5-3.8 with phosphoric acid.

The mixture is flash pasteurised and then filtered through a bed of diatomaceous earth. It is sterilised after bottling by heating to 100°C for 10 minutes.

The resultant product is a suitable concentrate for distribution to bottle plants for the purpose of adding a suitable quantity (four times its volume) of carbonated water, bottling and sterilising; alternatively it may be used as a concentrate for final dilution with water, carbonated water or other suitable diluents at actual point of sale. It may form a suitable ingredient for so-called "milk shakes" or other non-alcoholic beverages.

Example 4

Concentrated hydrolysed (1 litre) whey obtained exactly as outlined in Example 3 is filtered through a bed of diatomaceous earth. The resulting clear solution is concentrated to 300 mls in vacuo and, on chilling, 108 g. of the lactose contained therein is precipitated.

One then dilutes this product to twice its volume using chilled water in order to facilitate filtration and also to ensure that any soluble amino acids or peptides, which may have co-precipitated with the lactose, are brought back into solution. Only a small quantity of the originally precipitated lactose will re-dissolve by this procedure. The crystallised lactose is now removed by filtering through a suction filter. The liquid concentrate obtained contains 16-18% of lactose and 6.5-7.5% of protein in soluble form.

To the concentrate may be added other high protein containing foods such as soya flour. A suitable mixture has been found to be one part of the concentrate to one part of soya flour. After the addition of vitamins and mineral elements, this mixture may be bottled or filled into can or other suitable containers, and sterilised.

WHAT WE CLAIM IS:—

1. A process for the production of a nutrient food base which comprises the steps of pasteurising whey and hydrolysing the pasteurised whey at a pH between 2.5 and 7.0 by means of a proteolytic enzyme operating under these pH conditions.

2. A process as claimed in claim 1 in which the whey is untreated natural whey.

3. A process as claimed in claim 1 in which the whey is condensed or is protein enriched prior to or after pasteurising.

4. A process as claimed in claim 1 in which reconstituted whey powder is used.

5. A process as claimed in any of the preceding claims in which the pasteurising is effected at temperatures between 75-100°C for 30 minutes to 5 seconds followed by rapid cooling.

6. A process as claimed in claim 5 in which, where ordinary liquid whey is used, the pasteurisation is effected at a temperature of about 80°C for about 1 minute.

7. A process as claimed in any of the preceding claims in which the hydrolysis is effected at a pH between 4.0 and 7.0.

8. A process as claimed in claim 7 in which the hydrolysis is effected at a pH between 5.0 and 6.0.

9. A process as claimed in any of the preceding claims in which the enzyme is one which will hydrolyse proteins to polypeptides rather than amino acids.

10. A process as claimed in any of claims 1-9 in which the enzyme is a pancreatic enzyme.

11. A process as claimed in claim 10 in which the enzyme is trypsin or pepsin.

12. A process as claimed in any of claims 1-9 in which the enzyme is a plant enzyme.

13. A process as claimed in claim 12 in which the enzyme is ficin or papain.

14. A process as claimed in any of claims 1-9 in which the enzyme is a bacterial or fungal proteinase.

15. A process as claimed in claim 14 in which the enzyme is a fungal proteinase derived from an organism of the genus *Aspergillus*.

16. A process as claimed in claim 15 in which the proteinase is derived from *Aspergillus oryzae*.

17. A process as claimed in claim 16 in which a hydrolysis temperature of 48-55°C is employed.

18. A process as claimed in any of the preceding claims in which the hydrolysis is carried out for such a time that not more than 40% of the total nitrogen of the product is precipitable by trichloroacetic acid.

19. A process as claimed in any of the preceding claims in which the hydrolysis is

carried out for such a time that not more than 25% of the total nitrogen of the product is precipitable by trichloroacetic acid.

20. A process as claimed in any of the preceding claims in which at least 25% of the nitrogen present in the product is present as free amino groups.

21. A process as claimed in any of the preceding claims in which at least 40% of the nitrogen present in the product is present as free amino groups.

22. A process as claimed in any of the preceding claims in which not more than 60% of the nitrogen present in the product is present as free amino groups.

23. A process as claimed in any of the preceding claims in which not more than 50% of the nitrogen present in the product is present as free amino groups.

24. A process as claimed in any of the preceding claims in which the resulting hydrolysate is subjected to concentration followed by cooling to cause lactose to come out of solution and the solid lactose is separated from the residual hydrolysate so as to obtain a hydrolysate having an increased protein : carbohydrate ratio.

25. A process as claimed in claim 24 in which the hydrolysate of increased protein : carbohydrate ratio has an analysis of about 6.5-7.5% hydrolysed protein and about 16.0-18.0% lactose.

26. A process as claimed in any of the preceding claims in which the hydrolysate is pasteurised after the hydrolysis step and/or after a further processing step.

27. A process as claimed in any of the preceding claims in which the hydrolysate is dried to a powder.

28. A process as claimed in claim 1 substantially as herein described in any of the Examples.

29. A whey hydrolysate when obtained by a process as claimed in any of the preceding claims.

30. A soft drink or a soft drink base comprising a whey hydrolysate as claimed in claim 29 in admixture with a sweetening agent and a flavouring agent.

31. A soft drink or a soft drink base as claimed in claim 30 having a pH between 2.5 and 5.0.

32. A soft drink or a soft drink base as claimed in claim 31 having a pH between 3.3-3.6.

33. A soft drink as claimed in any of claims 30-32 which is carbonated.

34. A soft drink as claimed in any of claims 30-33 in which the free product is pasteurised before or after filling into containers.

35. A soft drink as claimed in any of claims 30-34 also containing added lysine.

36. A dietary preparation comprising a whey hydrolysate as claimed in claim 29 in admixture with an edible non-calorigenic thickening agent.

37. A dietary preparation as claimed in claim 36 in which said thickening agent is a cellulose derivative, an alginic acid derivative, pectin or gelatin.

38. A dietary preparation as claimed in claim 36 or claim 37 containing one or more ingredients selected from flavouring materials, vitamins and other nutrients.

39. A dietary preparation as claimed in claim 38 containing added carbohydrate.

40. A food or food base comprising a whey hydrolysate as claimed in claim 29 in admixture with another high protein containing food.

41. A food or food base as claimed in claim 40 in which said high protein containing food is soya flour.

42. Each and every novel product, process and composition herein disclosed.

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